*Cl* **FM** *SC* **FM** *P* **8** *L* **23** # r03-2

Anslow, Peter — Ciena Corporation

*Comment Type* **E** *Comment Status* **D**

The names of the participants in the WG ballot stage should be added to the frontmatter.

*SuggestedRemedy*

Add the names of the WG ballot participants to the frontmatter.
Remove the names of all of the WG officers and editors from the list.
Apply footnote 1 to "Jonathan King":
"Not a member of the IEEE 802.3 working group at the beginning of the working group ballot."

*Proposed Response* *Response Status* **O**

*Cl* **000** *SC* **0** *P* *L* # r03-3

Anslow, Peter — Ciena Corporation

*Comment Type* **E** *Comment Status* **D**

Now that the P802.3cd draft is nearing the end of sponsor ballot, it is worth ensuring that all tables that split across pages have a "very thin" bottom ruling at the foot of the table on the first page.

*SuggestedRemedy*

Ensure that all tables that split across pages have a "very thin" bottom ruling at the foot of the table on the first page.
Applies to at least the table in 135.7.3, the table in 135.7.4.2, the table in 135.7.4.4, Table 136-11, Table 136-18 (2 places), Table 138-9, the table in 139.11.4.1, the table in 135G.5.4.1, and the table in 135G.5.4.2.

*Proposed Response* *Response Status* **O**

*Cl* **000** *SC* **0** *P* **1** *L* **2** # r03-1

Anslow, Peter — Ciena Corporation

*Comment Type* **E** *Comment Status* **D**

Provided that the IEEE SASB approve the IEEE Std 802.3 revision in their meeting on 14 June 2018, the "base_year" variable should be changed to 2018 throughout the draft.

*SuggestedRemedy*

Provided that the IEEE SASB approve the IEEE Std 802.3 revision in their meeting on 14 June 2018, change the "base_year" variable to 2018 in all of the files in the draft.

*Proposed Response* *Response Status* **O**

*Cl* **001** *SC* **1** *P* **1** *L* **1** # r03-6

Rannow, R K — IEEE/SELF

*Comment Type* **GR** *Comment Status* **D**

Various uses of undefined, and non-standard acronyms.

*SuggestedRemedy*

*Proposed Response* *Response Status* **O**

*Cl* **001** *SC* **1.4.387** *P* **40** *L* **39** # r03-5

Marris, Arthur — Cadence Design Syst

*Comment Type* **E** *Comment Status* **D**

Consider adding Clauses 107, 119, 133 to the PCS clauses listed in: 1.4.387 Physical Coding Sublayer (PCS)

*SuggestedRemedy*

Update 1.4.387 to include the PCS Clauses for the 25G, 50G, and 200G and 400G speeds.

Also do the same for the PMA clauses in 1.4.392, the PMD clauses in 1.4.393 and the PHY clauses in 1.4.391.

*Proposed Response* *Response Status* **O**

*Cl* **069** *SC* **69.2.3** *P* **87** *L* **10** # r03-4

Marris, Arthur — Cadence Design Syst

*Comment Type* **T** *Comment Status* **D**

In Table 69-3a correct 100GAUI references

*SuggestedRemedy*

100GAUI-4 C2C is defined in 135D
100GAUI-2 C2C is defined in 135F

*Proposed Response* *Response Status* **O**

*Cl* **135** *SC* **135.5.5** *P* **178** *L* **30** # r03-23

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **E** *Comment Status* **D**

Per D3.2 comment 33 and Style Manual

*SuggestedRemedy*

Change Note to NOTE

*Proposed Response* *Response Status* **O**

*Cl* **136** *SC* **136.9.3.4** *P* **226** *L* **16** # r03-18

Dudek, Michael — Cavium

*Comment Type* **TR** *Comment Status* **D**

The existing Transmitter Specifications allow transmitters to pass specification and provide significantly worse performance than the Transmitter used to test cables. This creates an inter-operability problem. A presentation will be made.

*SuggestedRemedy*

Add +3 to Equation 136-6

*Proposed Response* *Response Status* **O**

*Cl* **137** *SC* **137.9.2.1** *P* **249** *L* **52** # r03-19

Dudek, Michael — Cavium

*Comment Type* **TR** *Comment Status* **D**

The reference Tx used in COM has an ERL of over 21.5dB whereas the required specification for the Tx is only 15dB. This allows Tx's with significantly poorer performance to pass specification and creates an inter-operability problem. A presentation will be provided

*SuggestedRemedy*

Change the Tx ERL specification to 18dB.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.7.1** *P* **270** *L* **22** # r03-28

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **E** *Comment Status* **D**

D3.2 comment 41, accepted

*SuggestedRemedy*

Make the left column wider and the others narrower

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.7.1** *P* **270** *L* **22** # r03-27

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

A TDECQ limit of 4.5 dB still has not been justified, given that the same fibres and transmitter, and receiver front-ends that should not be worse, can do 100GBASE-SR4 (PAM2, almost the same signalling rate) without the FFE. king_3cd_02_0118 showed 1 to 2.5 dB with representative drive, and king_3cd_03_0518 shows better than 3.7 dB. chang_011018_3cd_01_adhoc-v2 showed 2.1 to 3.1 dB, the lower end with threshold adjust, although much of this was with PRBS15.
The high limit in the draft would require a better equalizer (e.g. more precise tap settings) than needed for the SMF PMDs. D.30 comment 119, D3.1 comment 70, D3.2 comment 40

*SuggestedRemedy*

Consider what actual PAM4 MMF transmitters do (more evidence like king_3cd_03_0518), and compare a minimally compliant 100GBASE-SR4 transmitter, and set the TDECQ limit accordingly, e.g. 4.0 dB.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.7.2** *P* **271** *L* **9** # r03-25

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

In D1.0, OMA-TDECQ was -5 dBm TBC, and the unstressed sensitivity was -7 dBm. Now, OMA-TDECQ is -5.9 and the implied unstressed sensitivity is about -7.3, equivalent to 50GBASE-LR and 1.5 dB harder for the receiver than 50GBASE-FR. The definition of TDECQ has changed a few times, which I think explains why the budget has gone up from 6 dB TBC to 6.5 dB. Min OMA at max TDECQ was -1 dBm TBC in D1.0, -1 in D3.2, is now -1.4. It looks like OMA-TDECQ should have been increased to -5.5 as the apparent TDECQ was reduced. king_3cd_01_0518 had proposed -5.7 dBm.

*SuggestedRemedy*

I think these changes restore the intent of D1.0, which was based on a TDECQ from about 0 to 4, to go with the present TDECQ which goes from about 0.5 to 4.5:
Increase OMA-TDECQ from -5.9 to -5.5 dBm. Increase SRS OMA from -3.4 back to -3 dBm (as in D1.0 and D3.2). Increase the other receiver sensitivity, equation 138-1, from max(-6.5, SECQ - 7.9) to max(-6.1, SECQ - 7.5).

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.7.3** *P* **271** *L* **42** # r03-26

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

The effect of modal noise and mode partition noise with a very high TDECQ transmitter (D.30 comment 119, D3.1 comment 70, D3.2 comment 40) and particularly with a very high penalty after equalization ("up the page": see TDECQ presentations) (D3.0 comment 116, D3.1 comment 71, D3.2 comment 46) is higher than with a more moderate penalty after equalization or without equalization as in 100GBASE-SR4. 100GBASE-SR4 takes this "Pcross" effect into account inside TDEC.

*SuggestedRemedy*

Reduce the headline TDECQ and limit TDECQ-10log10(Ceq) to make room for this in the budget, and/or
Adjust the definition of TDECQ for MMF to take this into account.
Adjust the budgets as needed.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.5** *P* **273** *L* **34** # r03-9

Stassar, Peter — Huawei Technologies

*Comment Type* **TR** *Comment Status* **D**

Since the acceptance of modified filter characteristics for SECQ, as a result of resolution to comment #r02-62 at the May 2018 meeting, the filter characteristics for TDECQ, transition time and SECQ are now inconsistent. The difference between TDECQ and SECQ is only the presence of a test fiber in TDECQ, so the filter characteristics should be the same. The filter characteristics for TDECQ, Transition time and SECQ, will need to be aligned. Similarly for Clauses 139.7 and 140.7

*SuggestedRemedy*

There are 3 options to resolve this comment: 1. Reverting decision of Pittsburgh on the SECQ filter.
2. Adopting the revised SECQ filter characteristics also for TDECQ and Transition Time.
3. If the current SECQ filter is not adequate for TDECQ then create a formulation that is adequate for TDECQ and apply it also to transition time and SECQ.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.5** *P* **273** *L* **40** # r03-30

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

In this draft, it is still possible to make a bad MMF transmitter with emphasis (e.g. with a distorted signal) that even an equalizer better than the reference equalizer won't be able to improve. Note the receiver is tested for a slow signal only, not for such signals. This issue is worse for MMF because of the high TDECQ limit and because the low bandwidth reference filter allows more Tx emphasis than for SMF.
But notice that in the survey (e.g. dawe_3cd_01b_0518 slide 8), the MMF points are to the right of 0.5 dB and below 2.5 dB, not near the upper left.
We need to exclude unnecessary regions, too high up the TDECQ map, that would waste equalizer power and complexity, and would allow non-resilient links if such signals were ever fielded.
D3.0 comment 116, D3.1 comment 71, D3.2 comment 46.

*SuggestedRemedy*

Limit TDECQ -10*log10(Ceq) to 0.5 dB less than the max. TDECQ.
E.g. for a MMF TDECQ limit of 4 dB, limit TDECQ -10*log10(Ceq) to 3.5 dB.
Add the limit to the transmitter and receiver (conditions of stressed receiver sensitivity test) tables if appropriate.
This limit protects the equalizer and decison circuit or A to D from very bad waveforms, while OMA-TDECQ protects the receiver front end from excessive sensitivity demands.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.5.1** *P* **273** *L* **45** # r03-32

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

For some equalizer architectures, precursors are much more expensive than post-cursors (sun_3cd_042518_adhoc).
D3.1 comment 73, D3.2 comments 7, 8, 48, 53.

*SuggestedRemedy*

When we have decided what range of MMF signals are useful and allowed, review the value of the second precursor considering chromatic and modal dispersion. If it's small, continue the improvement made in king_3cd_03_0118: change "Tap 1, tap 2, or tap 3, has" to "Tap 1 or tap 2 has".
There is a separate comment for SMF because the different TDECQ limit and dispersion there could lead to a different conclusion.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.5.1** *P* **274** *L* **1** # r03-31

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

TDECQ for MMF is measured through a specially low bandwidth, so for the same extreme transmitter emphasis, the reference equalizer's largest magnitude tap coefficient is larger (0.87 vs. 0.8 in dawe_3cd_01b_0518) than for SMF. Further, the survey results for MMF (green points, slide 3, dawe_3cd_01b_0518) are all to the right of +0.5 dB. So the spec can be made more realistic, which makes building the SRS tester easier as well as removing unnecessary design space from the receiver.

*SuggestedRemedy*

(Just for Clause 138) in "the largest magnitude tap coefficient, which is constrained to be at least 0.8", change 0.8 to 1.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.7** *P* **274** *L* **25** # r03-44

Le Cheminant, Greg

*Comment Type* **T** *Comment Status* **D**

The transmitter transition time measurement that has been added to optical transmitter specifications uses a square wave pattern of eight sequential 3's followed by eight sequential 0's. The long runs of symbols ensure stable amplitudes from which to derive the 20% and 80% signal level thresholds used to construct a transition time measurement. The TDECQ, OuterOMA, and extinction ratio measurements can be made from a single acquisition of the SSPRQ pattern. To simplify the transmitter test process, a transmitter transition time measurement should also be considered valid if performed on the SSPRQ pattern. In the SSPRQ pattern there are two 0000033333 and two 3333300000 sequences. A transition time measurement made on either of these sequences should be equivalent to the measurement made on the square wave pattern.

*SuggestedRemedy*

Change 138.8.7 line 25 from ""......using the test pattern....."" to ""..........using a test pattern....."" And line 36 from ""....square wave test pattern is used."" to ""....square wave test pattern is used. When the SSPRQ pattern is used, P0 is measured over the central 2UI of the run of 5 zeroes and P3 is measured over the central 2UI of the run of 5 threes in the 0000033333 or 3333300000 sequences". Also change table 138-12 page 272 line 37 from "Square wave" to "Square wave or 6"

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.7** *P* **274** *L* **28** # r03-33

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

1. For consistency and so that transition time is a free by-product of a TDECQ measurement as intended by D3.2 comment 54, we should be able to measure transition time on the same pattern as other things, SSPRQ, and with the same observation bandwidth.
2. As it is intended to exclude signals that would cause receive equalizer issues (e.g. require better linearity and/or finer AtoD or tap resolution or stronger tap weights), what matters is a fitted signal, not the actual signal. So the limit can be based on the average of the rising and falling edges rather than the slower of them.
3. Then, with a more consistent measurement, the limit might be tightened a little.

*SuggestedRemedy*

1. Add PRBS13Q and SSPRQ options for transition time measurement and associated P0 and P3: define the places in the patterns to measure, change the entry in Table 139-10, Test-pattern definitions and related subclauses, from "Square wave" to "4, 6 or square wave". If that doesn't work, consider changing to a maximum cursor strength limit, which really is a free by-product of a TDECQ measurement.
Check what difference it would make to measure in the 11.2 GHz bandwidth. If we do that for transmitters (free by-product) the limit for SRS would be that in 13.28125 GHz (going with SECQ).
2. Change "the slower of the time interval of the transition from 20% ..., or from 80% ..." to "the average of the time intervals of the transition from 20% ..., and from 80% ...".
3. Reduce 34 ps to 30-32 ps if appropriate.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.10** *P* **275** *L* **37** # r03-34

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

This says "The SECQ of the stressed receiver conformance test signal is measured according to 138.8.5, except that the combination of the O/E and the oscilloscope..." but 138.8.5 doesn't mention SECQ.

*SuggestedRemedy*

Change to "The SECQ of the stressed receiver conformance test signal is measured similarly to TDECQ according to 138.8.5, except that the combination of the O/E and the oscilloscope..."

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.10** *P* **275** *L* **40** # r03-29

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

D3.2 comment 62 proposed "to no less than 0.9 * 26.5625 GHz; afterwards the level doesn't grow past the level achieved at the abovementioned frequency" while this says "and at frequencies between 0.9 x 26.5625 GHz and 1.5 x 26.5625 GHz the response should not exceed the Bessel-Thomson response". As the Bessel-Thomson response continues to roll off between 0.9 x 26.5625 GHz and 1.5 x 26.5625 GHz, it's a significantly stricter requirement and may conflict with achieving an accurate response below 0.9 x 26.5625 GHz.

*SuggestedRemedy*

I just want to check if we really need such a particular and unusual requirement.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.10** *P* **275** *L* **43** # r03-39

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

The rule of "at least half of the dB value of the stressed eye closure" is not consistent with the transmitter specs (D3.2 comment 55) for any of the optical PMDs.

*SuggestedRemedy*

When we have decided where the corner between the "top limit" and the "diagonal limit" on the TDECQ map is (see other comments), align the SRS range to that:
Add another exception, saying that the requirement that the combination of the low-pass filter and the E/O converter should have a frequency response that results in at least half of the dB value of the stressed eye closure (SECQ) before the sinusoidal and Gaussian noise terms are added, does not apply.
Change "The signaling rate and the required stressed eye closure (SECQ) of the stressed receiver conformance test signal is specified in Table 138-9" to "The signaling rate, the required stressed eye closure (SECQ) and SECQ-10*log10(Ceq) of the stressed receiver conformance test signal are specified in Table 138-9. For a particular setup, one of SECQ and SECQ-10*log10(Ceq) matches the table and the other is lower. A pattern generator with emphasis may be used."
Do we want to give more advice about this, e.g. a 2-tap FIR, which one is the cursor? The FIR is to move the test condition to the left; to move it to the right the filter should be used.
Also in 138 and 140.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.10** *P* **275** *L* **45** # r03-24

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

In practice, the receiver may experience noise from modal noise and mode partition noise as well as from RIN. Although there is a small allocation for these in the budget, it would be as well to allow the SRS to use the anticipated amount of noise from all causes, not just from RIN.

*SuggestedRemedy*

Change "should be no greater than the RIN12OMA (max) specified for the transmit characteristics in Table 138-8" (which means -128 dB/Hz) to "-127 dB/Hz" or "-126 dB/Hz" as appropriate.

*Proposed Response* *Response Status* **O**

*Cl* **138** *SC* **138.8.10** *P* **275** *L* **50** # r03-35

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

The SRS recipe doesn't mention the largest magnitude tap coefficient limit. It should, else someone could create a very under-stressed signal (although not realistic) by applying too much emphasis.

*SuggestedRemedy*

Add: the largest magnitude tap coefficient in the SECQ calibration should be at least the limit given in 138.8.5.1 without the constraint mentioned there.

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.6** *P* **293** *L* **43** # r03-43

Liu, Hai-Feng — Intel Corporation

*Comment Type* **TR** *Comment Status* **D**

The primary benefit of introducing threshold adjustment in D3.2 was to improve the TDECQ and link BER penalty correlation. This change would also relax the TDECQ for those Tx with unequal sub-eyes. In D3.3, TDECQmax was reduced to keep the maximum sub-eye inequality no greater than before threshold adjustment was added. However, the proposed 0.4 dB reduction from 3.4 dB to 3 dB was based on the simulation/measurement for the worst symmetric eye compression case under 1% threshold adjustment. Applying the same 0.4 dB reduction in TDECQ max across the board will unnecessarily penalize a large portion of good Tx that would have nearly equal sub-eyes. These Tx will gain little in terms of TDECQ from the threshold adjustment, but the 0.4 dB reduction in TDECQmax will result in significant loss. In addition, the worst symmetric eye compression case is far from practical as it can be avoided at least for MZI and EML based Tx.

*SuggestedRemedy*

In Table 139-6, change TDECQ (max) of 50GBASE-FR from 2.8 dB to 3.2 dB.
In Table 139-6, change TDECQ (max) of 50GBASE-LR from 3 dB to 3.4 dB.
In Table 139-7, change "Stressed receiver sensitivity ... (max)" of 50GBASE-FR from -5.5 dB to -5.1 dB.
In Table 139-7, change "Stressed receiver sensitivity ... (max)" of 50GBASE-LR from -6.8 dB to -6.4 dB.
In Table 139-7, change "Stress eye closure for PAM4 (SECQ) of 50GBASE-FR from 2.8 dB to 3.2 dB
In Table 139-7, change "Stress eye closure for PAM4 (SECQ) of 50GBASE-LR from 3 dB to 3.4 dB
In Table 139-7, change foot note "c" from "... SECQ up to 2.8 dB for 50GBASE-FR and 3 dB for 50GBASE-LR." to "... SECQ up to 3.2 dB for 50GBASE-FR and 3.4 dB for 50GBASE-LR."
In Table 139-8, change "Power budget" of 50GBASE-FR from 7.2 dB to 7.6 dB.
In Table 139-8, change "Power budget" of 50GBASE-LR from 9.9 dB to 10.3 dB.
In Table 139-8, change "Allocation for penalties" of 50GBASE-FR from 3.2 dB to 3.6 dB.
In Table 139-8, change "Allocation for penalties" of 50GBASE-LR from 3.6 dB to 4 dB.
In 139.7.9, change "... SECQ up to 2.8 dB" to "... SECQ up to 3.2 dB" for 50GBASE-FR
In 139.7.9, change "... SECQ up to 3 dB" to "... SECQ up to 3.4 dB" for 50GBASE-LR.

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.6** *P* **293** *L* **43** # r03-21

Tamura, Kohichi — Oclaro

*Comment Type* **TR** *Comment Status* **D**

In D3.2, 1% OMA threshold adjustment was introduced to the TDECQ algorithm in order to improve the yields of transmitters with slightly unequal eye levels and to improve correlation between changes in TDECQ and receiver sensitivity. Real receivers have threshold adjustment capability exceeding 1%, so the changes will mainly benefit transmitters with some nonlinearity, such as DML, but not adversely impact receivers. However, in D3.3, TDECQ (max) of 50GBASE-FR and 50GBASE-LR were reduced from 3.2 dB to 2.8 dB and from 3.4 dB to 3 dB, respectively, which negated the improvement gained with threshold adjustment. Furthermore, highly linear transmitters, for which TDECQ is the same with or without threshold adjustment, were penalized by a reduction in TDECQ (max) by 0.4 dB.

*SuggestedRemedy*

In Table 139-6, change TDECQ (max) of 50GBASE-FR from 2.8 dB to 3.2 dB.
In Table 139-6, change TDECQ (max) of 50GBASE-LR from 3 dB to 3.4 dB.

These changes will require additional changes as described below in other parts of the draft.
In Table 139-7, change "Stressed receiver sensitivity ... (max)" of 50GBASE-FR from -5.5 dB to -5.1 dB.
In Table 139-7, change "Stressed receiver sensitivity ... (max)" of 50GBASE-LR from -6.8 dB to -6.4 dB.
In Table 139-7, change foot note "c" from "... SECQ up to 2.8 dB for 50GBASE-FR and 3 dB for 50GBASE-LR." to "... SECQ up to 3.2 dB for 50GBASE-FR and 3.4 dB for 50GBASE-LR."
In Table 139-8, change "Power budget" of 50GBASE-FR from 7.2 dB to 7.6 dB.
In Table 139-8, change "Power budget" of 50GBASE-LR from 9.9 dB to 10.3 dB.
In Table 139-8, change "Allocation for penalties" of 50GBASE-FR from 3.2 dB to 3.6 dB.
In Table 139-8, change "Allocation for penalties" of 50GBASE-LR from 3.6 dB to 4 dB.
In 139.7.9, change "... SECQ up to 2.8 dB" to "... SECQ up to 3.2 dB" for 50GBASE-FR
In 139.7.9, change "... SECQ up to 3 dB" to "... SECQ up to 3.4 dB" for 50GBASE-LR.
In 139.7.9, change Figure 139-6 so that curves include SECQ of 3.2 dB and 3.4 dB for 50GBASE-FR and 50GBASE-LR, respectively.

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.7.5.3** *P* **298** *L* **52** # r03-36

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

In this draft, it is still possible to make a bad SMF transmitter with emphasis (e.g. with a distorted signal) that even an equalizer better than the reference equalizer won't be able to improve. Note the receiver is tested for a slow signal only, not for such signals. But notice that in the survey (e.g. dawe_3cd_01b_0518 slide 8), the 50G SMF points are near neutral and below 1.8 dB, not near the upper left.
We need to exclude unnecessary regions, too high up the TDECQ map, that would waste equalizer power and complexity.
D3.0 comment 116, D3.1 comment 71, D3.2 comment 52.

*SuggestedRemedy*

Limit TDECQ -10*log10(Ceq) to the lower of 3 dB or the max. TDECQ.
E.g. for a SMF TDECQ limit of 2.8 dB (50GBASE-FR), limit TDECQ -10*log10(Ceq) to 2.8 dB; for 3 dB (50GBASE-LR), limit TDECQ -10*log10(Ceq) to 3 dB.
Add the limit to the transmitter and receiver (conditions of stressed receiver sensitivity test) tables if appropriate.
This limit protects the equalizer and decison circuit or A to D from worse than reasonable waveforms, while OMA-TDECQ protects the receiver front end from excessive sensitivity demands.

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.7.5.4** *P* **299** *L* **5** # r03-37

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

For some equalizer architectures, precursors are much more expensive than post-cursors (sun_3cd_042518_adhoc). Further investigation of possible minimally compliant SMF signals and their associated TDECQ FFE settings indicates that 2 pre, 2 post (making the cursor the third tap) is never significantly better than 1 pre, 3 post (making it the second tap), for compliant signals (but not yet including chromatic dispersion). See dawe_3cd_01a_0318. Further refining the TDECQ search rules will avoid inefficiency both in product receiver design, testing and operation, and in TDECQ testing. D3.1 comment 76, D3.2 comment 53.

*SuggestedRemedy*

Review the value of the second precursor considering chromatic dispersion. If it's small, continue the improvement made in king_3cd_03_0118: change "Tap 1, tap 2, or tap 3, has" to "Tap 1 or tap 2 has", like 100GBASE-DR. Increase the max TDECQ a little if appropriate.
There is a separate comment for MMF because the different TDECQ limit there could lead to a different conclusion.

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.7.5.4** *P* **299** *L* **22** # r03-47

Sun, Phil

*Comment Type* **T** *Comment Status* **D**

Current spec allows TDECQ reference receiver to have up to two precursors for 50GBASE-FR and 50GBASE-LR. As explained in sun_3cd_042518_adhoc, this forces receivers to implement multiple precursors and choose power-hungry solutions. As a result, module power will be kept high forever to ensure interoperability with bad transmitters. On the other hand, precursor 2 impact on TDECQ is minimal for 50GBASE-FR and small for 50GBASE-LR. Meanwhile it can be compensated by TX. Allowing no more than 1 precursor also helps to reduce test time.

*SuggestedRemedy*

"Add:
For 50GBASE-FR, Tap 1 or tap 2 has the largest magnitude tap coefficient."

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.7.7** *P* **299** *L* **34** # r03-45

Le Cheminant, Greg

*Comment Type* **T** *Comment Status* **D**

The transmitter transition time measurement that has been added to optical transmitter specifications uses a square wave pattern of eight sequential 3's followed by eight sequential 0's. The long runs of symbols ensure stable amplitudes from which to derive the 20% and 80% signal level thresholds used to construct a transition time measurement. The TDECQ, OuterOMA, and extinction ratio measurements can be made from a single acquisition of the SSPRQ pattern. To simplify the transmitter test process, a transmitter transition time measurement should also be considered valid if performed on the SSPRQ pattern. In the SSPRQ pattern there are two 0000033333 and two 3333300000 sequences. A transition time measurement made on either of these sequences should be equivalent to the measurement made on the square wave pattern.

*SuggestedRemedy*

Change 139.7.7 line 34 from ""......using the test pattern....."" to ""..........using a test pattern....."" And line 45 from ""....square wave test pattern is used.""  to ""....square wave test pattern is used.  When the SSPRQ pattern is used, P0 is measured over the central 2UI of the run of 5 zeroes and P3 is measured over the central 2UI of the run of 5 threes in the 0000033333 or 3333300000 sequences". Also change Table 139-10 page 296 line 16 from "Square wave" to "Square wave or 6"

*Proposed Response* *Response Status* **O**

*Cl* **139** *SC* **139.7.7** *P* **299** *L* **37** # r03-38

Dawe, Piers J G Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

1. For consistency and so that transition time is a free by-product of a TDECQ measurement as intended by D3.2 comment 54, we should be able to measure transition time on the same pattern as other things, SSPRQ.
2. As it is intended to exclude signals that would cause receive equalizer issues (e.g. require better linearity and/or finer AtoD or tap resolution or stronger tap weights), what matters is a fitted signal, not the actual signal. So the limit can be based on the average of the rising and falling edges rather than the slower of them. Then, with a more consistent measurement, the limit can be tightened a little.
3. We should consider tightening the limit for 50GBASE-FR and 50GBASE-LR; it's the same as for MMF with a slower observation bandwidth and much higher TDECQ.

*SuggestedRemedy*

1. Add PRBS13Q and SSPRQ options for transition time measurement and associated P0 and P3: define the places in the patterns to measure, change the entry in Table 139-10, Test-pattern definitions and related subclauses, from "Square wave" to "4, 6 or square wave". If that doesn't work, consider changing to a maximum cursor strength limit, which really is a free by-product of a TDECQ measurement.
2. Change "the slower of the time interval of the transition from 20% ..., or from 80% ..." to "the average of the time intervals of the transition from 20% ..., and from 80% ...".
3. Reduce 34 ps to 28-32 ps TBD, considering the effect of the different observation bandwidth.

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.6** *P* **318** *L* **42** # r03-42

Liu, Hai-Feng — Intel Corporation

*Comment Type* **TR** *Comment Status* **D**

The primary benefit of introducing threshold adjustment in D3.2 was to improve the TDECQ and link BER penalty correlation. This change would also relax the TDECQ for those Tx with unequal sub-eyes. In D3.3, TDECQmax was reduced to keep the maximum sub-eye inequality no greater than before threshold adjustment was added. However, the proposed 0.4 dB reduction from 3.4 dB to 3 dB was based on the simulation/measurement for the worst symmetric eye compression case under 1% threshold adjustment. Applying the same 0.4 dB reduction in TDECQ max across the board will unnecessarily penalize a large portion of good Tx that would have nearly equal sub-eyes. These Tx will gain little in terms of TDECQ from the threshold adjustment, but the 0.4 dB reduction in TDECQmax will result in significant loss. In addition, the worst symmetric eye compression case is far from practical as it can be avoided at least for MZI and EML based Tx.

*SuggestedRemedy*

In Table 140-6, change "TDECQ (max)" of 100GBASE-DR from 3 dB to 3.4 dB.
In Table 140-7, change "stressed receiver sensitivity ... (max)" of 100GBASE-DR from -2.3 dB to -1.9 dB.
In Table 140-7, change foot note "c" from "... SECQ up to 3 dB." to "... SECQ up to 3.4 dB."
In Table 140-8, change "Power budget" of 100GBASE-DR for extinction ratio >= 5 dB from 6.1 dB to 6.5 dB.
In Table 140-7, change the Stressed eye closure for PAM4 (SECQ) from 3 dB to 3.4 dB
In Table 140-8, change "Power budget" of 100GBASE-DR for extinction ratio < 5 dB from 6.4 dB to 6.8 dB.
In Table 140-8, change "Allocation for penalties" of 100GBASE-DR for extinction ratio >= 5 dB from 6.1 dB to 6.5 dB.
In Table 140-8, change "Allocation for penalties" of 100GBASE-DR for extinction ratio < 5 dB from 6.4 dB to 6.8 dB.
In page 323, 140.7.9, Change "...SECQ up to 3 dB" to "...SECQ up to 3.4 dB"

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.6** *P* **318** *L* **42** # r03-22

Tamura, Kohichi — Oclaro

*Comment Type* **TR** *Comment Status* **D**

In D3.2, 1% OMA threshold adjustment was introduced to the TDECQ algorithm in order to improve the yields of transmitters with slightly unequal eye levels and to improve correlation between changes in TDECQ and receiver sensitivity. Real receivers have threshold adjustment capability exceeding 1%, so the changes will mainly benefit transmitters with some nonlinearity, such as DML, but not adversely impact receivers. However, in D3.3, TDECQ (max) of 100GBASE-DR reduced from 3.4 dB to 3 dB, which negated the improvement gained with threshold adjustment. Furthermore, highly linear transmitters, for which TDECQ is the same with or without threshold adjustment, were penalized by a reduction in TDECQ (max) by 0.4 dB.

*SuggestedRemedy*

In Table 140-6, change "TDECQ (max)" of 100GBASE-DR from 3 dB to 3.4 dB.
In Table 140-7, change "stressed receiver sensitivity ... (max)" of 100GBASE-DR from -2.3 dB to -1.9 dB.
In Table 140-7, change foot note "c" from "... SECQ up to 3 dB." to "... SECQ up to 3.4 dB."
In Table 140-7, change the "Stressed eye closure for PAM4 (SECQ)" from 3 dB to 3.4 dB
In Table 140-8, change "Power budget" of 100GBASE-DR for extinction ratio >= 5 dB from 6.1 dB to 6.5 dB.
In Table 140-8, change "Power budget" of 100GBASE-DR for extinction ratio < 5 dB from 6.4 dB to 6.8 dB.
In Table 140-8, change "Allocation for penalties" of 100GBASE-DR for extinction ratio >= 5 dB from 6.1 dB to 6.5 dB.
In Table 140-8, change "Allocation for penalties" of 100GBASE-DR for extinction ratio < 5 dB from 6.4 dB to 6.8 dB.
In 140.7.9, change "...SECQ up to 3 dB" to "...SECQ up to 3.4 dB"
In 140.7.9, change Figure 140-5 so curve includes up to SECQ of 3.4 dB.

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.1** *P* **321** *L* **5** # r03-10

Stassar, Peter — Huawei Technologies

*Comment Type* **ER** *Comment Status* **D**

In 3 instances in Table 140-10, 50GBASE-R is mentioned, which should be 100GBASE-R. Thanks to David Lewis for identifying this error.

*SuggestedRemedy*

Where applicable in Table 140-10 change "50GBASE-R" to "100GBASE-R"

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.1** *P* **321** *L* **17** # r03-17

Dudek, Michael — Cavium

*Comment Type* **TR** *Comment Status* **D**

Measuing RIN with pattern 4 using the measurement methodology of 52.9.6 will result in the wrong result.

*SuggestedRemedy*

Change the pattern to "square wave" (as is already used in Clauses 138 and 139).

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.5** *P* **322** *L* **25** # r03-40

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **TR** *Comment Status* **D**

In this draft, it is still possible to make a bad SMF transmitter with emphasis (e.g. with a distorted signal) that even an equalizer better than the reference equalizer won't be able to improve. Note the receiver is tested for a slow signal only, not for such signals. But notice that in the survey (e.g. dawe_3cd_01b_0518 slide 8), the 100G SMF points are to the right or near neutral, not at the upper left.
We need to exclude unnecessary regions, too high up the TDECQ map, that would waste equalizer power and complexity.
D3.0 comment 116, D3.1 comment 71, D3.2 comment 52.

*SuggestedRemedy*

Limit TDECQ -10*log10(Ceq) to the the max. TDECQ.
E.g. for a SMF TDECQ limit of 3 dB (100GBASE-DR), limit TDECQ -10*log10(Ceq) to 3 dB; if it is increased to 3.4 dB, limit TDECQ -10*log10(Ceq) to 3.4 dB.
Add the limit to the transmitter and receiver (conditions of stressed receiver sensitivity test) tables if appropriate.
This limit protects the equalizer and decison circuit or A to D from worse than reasonable waveforms, while OMA-TDECQ protects the receiver front end from excessive sensitivity demands.

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.7** *P* **323** *L* **6** # r03-46

Le Cheminant, Greg

*Comment Type* **T** *Comment Status* **D**

The transmitter transition time measurement that has been added to optical transmitter specifications uses a square wave pattern of eight sequential 3's followed by eight sequential 0's. The long runs of symbols ensure stable amplitudes from which to derive the 20% and 80% signal level thresholds used to construct a transition time measurement. The TDECQ, OuterOMA, and extinction ratio measurements can be made from a single acquisition of the SSPRQ pattern. To simplify the transmitter test process, a transmitter transition time measurement should also be considered valid if performed on the SSPRQ pattern. In the SSPRQ pattern there are two 0000033333 and two 3333300000 sequences. A transition time measurement made on either of these sequences should be equivalent to the measurement made on the square wave pattern.

*SuggestedRemedy*

Change 140.7.7 line 6 from ""......using the test pattern....."" to ""..........using a test pattern....."" And line 17 from ""....square wave test pattern is used."" to ""....square wave test pattern is used. When the SSPRQ pattern is used, P0 is measured over the central 2UI of the run of 5 zeroes and P3 is measured over the central 2UI of the run of 5 threes in the 0000033333 or 3333300000 sequences". Also change Table 140-10 Page 321 line 16 from "Square wave" to "Square wave or 6"

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.7** *P* **323** *L* **9** # r03-41

Dawe, Piers J G — Mellanox Technologie

*Comment Type* **T** *Comment Status* **D**

1. For consistency and so that transition time is a free by-product of a TDECQ measurement as intended by D3.2 comment 54, we should be able to measure transition time on the same pattern as other things, SSPRQ.
2. As it is intended to exclude signals that would cause receive equalizer issues (e.g. require better linearity and/or finer AtoD or tap resolution or stronger tap weights), what matters is a fitted signal, not the actual signal. So the limit can be based on the average of the rising and falling edges rather than the slower of them.

*SuggestedRemedy*

1. Add PRBS13Q and SSPRQ options for transition time measurement and associated P0 and P3: define the places in the patterns to measure, change the entry in Table 140-10, Test-pattern definitions and related subclauses, from "Square wave" to "4, 6 or square wave". If that doesn't work, consider changing to a maximum cursor strength limit, which really is a free by-product of a TDECQ measurement.
2. Change "the slower of the time interval of the transition from 20% ..., or from 80% ..." to "the average of the time intervals of the transition from 20% ..., and from 80% ...".

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.10** *P* **324** *L* # r03-8

Stassar, Peter Huawei Technologies

*Comment Type* **TR** *Comment Status* **D**

140.7.10 should have an exception to use Figure 139-7 because it is a single lane PMD, in a similar way as in Subclause 139.7.10.2

*SuggestedRemedy*

Add another exception, "An example stressed receiver conformance test setup is shown in Figure 139-7; however, alternative test setups that generate equivalent stress conditions may be used."

*Proposed Response* *Response Status* **O**

*Cl* **140** *SC* **140.7.10** *P* **324** *L* **47** # r03-7

Stassar, Peter Huawei Technologies

*Comment Type* **TR** *Comment Status* **D**

An exception, referring to test patterns in Table 140-10, is missing.

*SuggestedRemedy*

Add another exception "The test patterns used for stressed receiver sensitivity are specified in Table 140-10."

*Proposed Response* *Response Status* **O**